POLYNESIAN THOMISIDAE - A MEETING OF OLD AND NEW WORLD GROUPS

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Lehtinen, P.T. 1993 11 11: Polynesian Thomisidae - a meeting of old and new world groups. *Memoirs of the Queensland Museum* **33**(2): 585-591. Brisbane. ISSN 0079-8835.

The Polynesian thomisid fauna is postulated as consisting of an Hawaiian-east Polynesian New World group, living mainly in isolated populations in the mountains and of representatives of two western lowland groups originating from Australia and Southeast Asia. The former group has apparently speciated into numerous endemic species, while the latter groups are represented by a single, widespread species and a rare Tongan species, respectively. The ranges of the eastern and western groups do not overlap. The species of New World origin have been described or previously attributed to *Misumena*, *Misumenops*, or *Synaema*. All such species are included here in *Mecaphesa* Simon, 1900 with the type species from Hawaii. *Misumenops* F.O. Pickard-Cambridge, 1900 has the type species from Eastern Brazil and has no close relatives in Polynesia or in the Old World. A widespread Old World group is also recognized here and tentatively included in *Massuria* which appear to be related to the New Guinean *Loxoporetes*. *Diaea* as currently recognized is polyphyletic and the species occurring in west Polynesia (*Diaea praetexta* (L. Koch, 1865)) is postulated to belong to a group requiring a new generic delimitation and name. *Hedana subtilis* L. Koch, 1874, also of Asian origin is here regarded as having affinity with *Tharrhalea*. The poorly described thomisid species of the isolated, southernmost island group of Polynesia, Rapa Island has not been studied. □*Araneae, Thomisidae, Polynesia, biogeography.*

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Many zoogeographical discussions, including spiders, are flawed because of poor taxonomy. The zoogeography of the Polynesian spider fauna has been discussed by Berland (1927, 1928, 1929, 1930, 1933, 1934a, b, c, 1935a, b, 1937, 1938a, b, 1942, 1947), but his discussions were based on unrevised taxa. His conclusions were often affected by misidentifications and unevenness of data available. Most spiders for these papers consisted of assorted samples made by non-specialists and many were synanthropic species found near villages.

I have been working towards a zoogeographical synthesis of the Polynesian spider fauna for ten years. Extensive personal field work in mountain tops, but also in the disturbed zone has been the most important method in the elimination of anthropochorous dispersal and distinctly synanthropic species from all speculations on the origin of the fauna of natural habitats.

The taxonomic revision of all families present seems to be necessary for any valid zoogeographical conclusions. As the first step I have carried out a 'generic' revision of Polynesian families which allows the placing of most Polynesian species groups of spiders into named or still unnamed groups of supraspecific taxa instead of zoogeographically useless concepts such as the 'worldwide' *Misumenops*, *Theridion*, *Hahnia*, or *Leucauge*. Some recent papers on Polynesian spiders have been published (e.g. Marples, 1955a, b, 1957, 1959, 1960, 1964; Berry and Beatty, 1987; Beatty and Berry, 1988; Beatty *et al.*, 1991). I have previously discussed some aspects of the spider zoogeography of the Pacific region (Lehtinen, 1980). Polynesian thomisids have also been described by Strand (1913).

The evolution of Polynesian Thomisidae has resulted in the most striking example of local speciation of spiders in Polynesia. The Thomisidae discussed comprise only the subfamily Thomisinae in the sense of Suman (1970) and various other authors. The Philodromidae are not a sister group of Thomisidae, but rather of the Heteropodidae.

The geological history of the Polynesian archipelagoes is now well known (Wilson, 1963; Duncan and McDougall, 1974; Dalrymple *et al.*, 1975). An ancient continent of Pacifica has been proposed (with differing placement and size) marginally affecting to the historical zoogeography of Polynesia (e.g. Nur and Ben-Avraham, 1977; Craw, 1983). Most geophysicists agree that the Polynesian islands are not parts of ancient land masses broken by processes of the plate tectonics, but rather chains of current islands and

seamounts representing former islands (Dalrymple *et al.*, 1975).

The origin of the Polynesian fauna therefore can be explained only by long distance dispersal from different directions (Gressitt and Yoshimoto, 1963) and partly by intrapolynesian speciation processes within the island chains (cf. also Carson, 1984; Fosberg, 1991). The use of the basic principles of the vicariance biogeography (Nelson and Platnick, 1981) will be essential for explaining the origin of groups of biota with complex patterns in their recent ranges. Craw's (1978) variant of panbiogeography, later named spanning-tree biogeography by Platnick and Nelson (1988) is a useful method for comparisons of area including also permanently oceanic island groups and it can be recommended for the analysis of many other groups of spiders. When patterns of distribution are very simple and anthropochorous dispersal in historical time has not thoroughly obscured the original patterns (cf. Stoddart, 1968), conclusions can be made with Craw's method such as have actually long been used by zoogeographers (e.g. Gressitt, 1961) before the concept of 'the most parsimonious area relationship' was defined and named.

In spite of the current taxonomic confusion of the Thomisidae on a global scale some generalisations on the zoogeography of the family are possible in the Pacific area. This paper presents the suggested relationships and zoogeography of the Thomisidae of Polynesia according to rich new material and results of my unpublished revisional work.

TAXONOMIC REMARKS

The nominate subfamily of Thomisidae should be called Thomisinae, although the name Misumeninae has been widely used, also, e.g. recently by Dippenaar-Schoeman (1983). Two groups of greenish or yellowish species without abdominal modifications are easily recognizable, one with conspicuous modifications in the ocular area (*Thomisus*-group), the other without such modifications (*Misumena*-group). The limitation of thomisine groups has been vague. Simon (1895) originally listed *Misumena*, *Heriaeus*, and *Diaea* in different tribes, while at the other extreme, the *Misumena*-group of Dippenaar-Schoeman (1983) includes not only *Thomisus*, but also *Runcinia*.

No phylogeny of thomisine groups is known and detailed discussion is beyond the scope of this study. However, the *Misumena*-group has apparently retained many plesiomorphic characters. Some groups with striking individual adaptive modifications (e.g. *Heriaeus* and *Runcinia*) may be closely related to this group.

There are most probably many other endemic species of Thomisinae in the mountains of French Polynesia, but a revision is excluded here.

The definition and delimitation of thomisine genera has been based traditionally on a few adaptive characters, including number, length, and type of setae on the carapace (Simon, 1895; Mello-Leitão, 1929; Schick, 1965; Tikader, 1980; Dondale and Redner, 1978; Levy 1985; Ono, 1988), but little attention has been paid to general patterns of the genital organs and type of sexual dimorphism. In contrast to conventions in the taxonomy of other spider groups, the naming of individual setae of the thomisid carapace has been used by some recent specialists (Schick, 1965; Dippenaar-Schoeman, 1983). This terminology is widespread in acarine taxonomy.

Some genera have been very obscurely defined and therefore all catalogues list them as being very widespread and species rich, e.g. *Misumena*, *Misumenops*, *Diaea*, and *Synaema*. All these generic names appear in thomisids described or listed from Polynesia. Even a superficial comparison of the descriptions or type material from many species of these genera (L. Koch, 1874; Kulczynski, 1911; Chrysanthus, 1964; Tikader, 1980) reveals that they are typical 'waste-basket' groups, where most species are not closely related to the respective type species.

The phylogenetic classification of the west Polynesian '*Diaea*' and the east Polynesian '*Misumenops*' has been time-consuming, as all basic taxonomic work on Indo-Pacific and Neotropical Thomisidae was done before modern taxonomic principles and methods became established. Most structural characters used as generic criteria in Thomisidae seem to be minor convergently evolved adaptations. The type species of all three large widespread genera in question, *Misumenops*, *Diaea*, and *Misumena*, are atypical or 'peripheral' species, not closely related to the Pacific species. Actually the placing of many tropical species in these three genera have been repeatedly changed, depending mainly on emphasis laid on single adaptive characters, e.g. type and pattern of setae on carapace, pattern of leg spines, eye pattern, etc.

The setation of the carapace is variable in the Polynesian groups of Thomisidae. Nevertheless, in *Mecaphesa*, sympatric species may be best identified by differences in length and density of

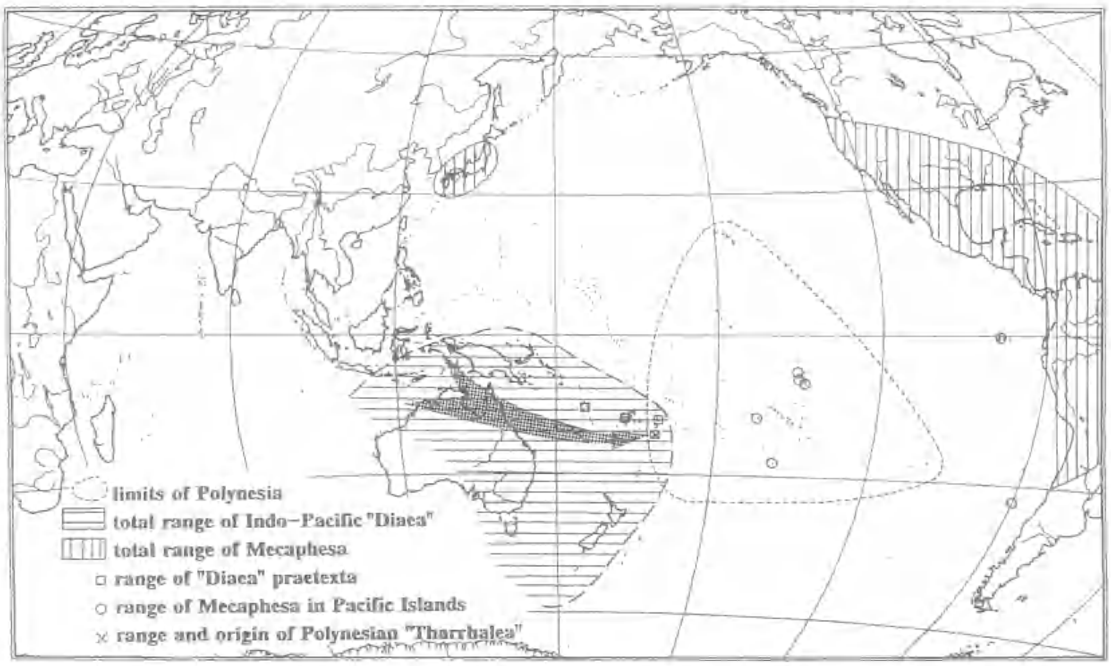

FIG. 1. Geographic ranges and source of Polynesian thomisid groups.

the carapace setae. The shape of the carapace is variable in *Mecaphesa*, while the shape of the abdomen is variable in both '*Diaea*' and *Mecaphesa*, even within one population.

The colour pattern is variable also, although the 'usual' colouration for most species provides a reasonable guide to identification, if large populations are available.

POLYNESIAN THOMISIDS OF NEW WORLD ORIGIN

Most east Polynesian thomisids have been long included in *Misumenops* F.O. Pickard-Cambridge, 1900 (Berland, 1933, 1934b, 1942; Suman, 1970), although Roewer (1954) transferred all Hawaiian species to *Misumenoides* F.O. Pickard-Cambridge, 1900.

Many Hawaiian and North American species of *Misumenops* sensu Schick (1965) were originally described in *Misumena* or *Diaea*, and Neotropical species also in *Metadiaea* Mello-Leitão, 1929.

The adaptive radiation of Hawaiian Thomisidae indicates that essential changes in the shape of the carapace are possible without other than minor changes in the male palpal structure. The Hawaiian thomisid species were listed by Simon (1900) in *Misumena* (6 spp.), *Diaea* (2 spp.), *Synaema* (4 spp.), and *Mecaphesa* (2 spp.), but by Suman (1970) in *Misumenops* (14 spp), *Synaema* (1) and *Mecaphesa* (3 spp.). I have checked the type material of all Hawaiian thomisids preserved in the Bishop Museum and, in my opinion, both male and female genitalia of *Synaema naevigerum* Simon, 1900 are much closer to the genitalia of all Hawaiian '*Misumenops*' than those of the type of *Synaema*, *S. globosum* (Fabricius, 1775) from Europe. The relative width of the ocular area is certainly a parallelism in true *Synaema* and the Hawaiian '*Synaema*'. The blunt setae of *Mecaphesa* s. str. have been independently modified, and the three species constitute a sister group of the Hawaiian '*Misumenops*' and '*Synaema*' together. The genital organs of both sexes are again more or less similar and not at all related to *Oxyptila* or *Heriaeus*, as claimed by Simon (1900). Suman (1970) was not familiar with the Palaearctic thomisids and had no opinion on this matter, but be published useful drawings of the genitalia of all Hawaiian thomisids. This group of '*Misumenops*' is also present in Japan, as *Misumenops kumadai* Ono, 1985 and in western North America at least 13 species (*celer*-group), listed by Schick (1965) in *Misumenops (Misumenops)*. *Misumenops inclusus* Banks, 1902 from Galapagos Islands and *M. sjoestedti* Berland, 1924 from Juan Fernandez Islands are

SE Asian/Australian origins (western lowlands)	Neotropical origins (eastern highlands)	Uncertain origin (Rapa)
'Diaea' praetexta belongs to probably new group *'Hedana subtilis'* belongs to *Tharrhalea*	Species previously attributed to *Misumena*, *Misumenops* and *Synaema*	*'Misumenops' rapaensis*

TABLE 1. Hypothesis of generic placement and zoogeographic origins of species groups of Thomisidae represented in Polynesia.

additional members of this genus in the Pacific region.

The generic name *Misumenops* is here reserved for the group of Neotropical species that are unambiguously related to *M. maculissparsa* (Keyserling, 1891), a species with a well developed tutacular process in cymbium and a complex of tibial apophyses that is widely different from any Pacific species. *M. pallens* (Keyserling, 1880) and *M. pallida* (Keyserling, 1880) were recently revised by Rinaldi (1983) without comparison to the type species. These widespread Neotropical species are not close to *M. maculissparsa*, but they may remain in the same genus. On the other hand, the concept of *Mecaphesa* is here widened to also include most Polynesian, some other Pacific and many north American *'Misumenops'*, the more plesiomorphic branch of this genus. *'Misumenops' rapaensis* Berland (Berland, 1934) from the isolated Rapa Island with a terrestrial fauna of peculiar affinities probably belongs elsewhere.

The widespread Holarctic *M. tricuspidatus* (Fabricius, 1775) is removed from this genus, but its final generic placement must wait for a more complete revision of Thomisinae: Misumenini. The structure of the male tibial apophysis, including the microstructure of its tip, is different from all other thomisids known to me. *M. japonicus* (Bösenberg and Strand, 1906) is a relative or even a member of *Diaea*, while the *asperatus* group of *Misumenops* (Schick, 1965) may belong to *Metadiaea* and the *coloradensis* group represents a distinct genus, not close to *Mecaphesa* or *Misumenops*.

The synonymic history of *Metadiaea* is confusing, too, as the authors discussing this problem (Toledo Piza, 1937; Caporiacco, 1954; Rinaldi, 1983) have based their opinions on the data from species other than the type species, *M. fidelis* Mello- Leitão, 1929 from Minas Gerais, Brazil. I agree with Rinaldi (1983) in transferring the other species to *Misumenops pallida*-group, but not the type of the genus, and *Metadiaea* remains a valid American genus probably including also North American species.

There is a widespread Southeast Asian-New Guinean group with short scutate male abdomen and with genital organs of both sexes close to *Runcinia*. Their male tibial apophysis is similar to *Mecaphesa*, including the characteristic ribbed tip. The New Guinean *Loxoporetes* known only by the female is probably related to, or even congeneric with this group, of which most species have been described as *Misumena*. This group will probably be named *Massuria* Thorell, 1887 and it might be a plesiomorphic sister group of the widespread and widely sympatric *Runcinia*.

POLYNESIAN THOMISIDS OF OLD WORLD OR AUSTRALIAN ORIGIN

The greenish thomisids from Samoa and Tonga islands have been described as different species (L. Koch, 1874; Rainbow, 1902: New Hebrides; Strand, 1913), all referred to *Diaea*. A critical survey of several large populations reveals that there is only one widespread species, *'D.' praetexta* (L. Koch, 1865) with large infrapopulational variation in the colour pattern, but quite small variation in the structure of the genital organs. In contrast to east Polynesian and Hawaiian thomisids this species lives in the vegetation of lowlands and is also common in Fiji and Vanuatu.

At least *D. sticta* and *D. limbata* (Kulczynski, 1911) within the widespread and common Melanesian *Diaea* spp. as well as the east Australian *D. multopunctata* L. Koch, 1874 and *D. prasina* L. Koch, 1876 are congeneric with *D. praetexta*. This group of Australian-Polynesian *'Diaea'* deserves generic status, but until some 'old' thomisine genera from the Indo-Pacific area have been revised the erection of a new genus would be hasty. The type species of *Diaea*, *Araneus dorsatus* Fabricius, 1775, probably together with some other Palaearctic species has male and female genital organs resembling *Heriaeus* (Loerbroks, 1983). The deviating non-genitalic characters of *Heriaeus* are adaptations to life in the desert.

Hedana subtilis L. Koch, 1874 was described from one male and a juvenile from Tonga, western Polynesia. Most probably it is not congeneric with the Australian type species *H. gracilis* L. Koch, 1874 and several other species

from Southeast Asia to New Zealand. It has not been compared with the type of *Tharrhalea* from N. Australia, but it seems, at least, to belong to the same tribe as *T. maculata* from New Guinea. *H. pallida* Koch, 1876, described from juvenile specimens from Tonga most probably is a synonym of *H. subtilis* or even '*D.*' *praetexta*. In addition to these two very old records there is also a recent record of a subadult female from Tonga. *Hedana* and *Tharrhalea* have been catalogued in Stephanopinae (Simon, 1895; Roewer, 1954; Bonnet, 1957), but '*H.*' *subtilis* belongs to Thomisinae.

I have seen relatives of *H. subtilis* (? *Tharrhalea*) in New Guinea and southeast Asia and the range of this unnamed group is more or less similar, but possibly extending farther northwards, when compared to that of the '*Diaea*' *praetexta*-group.

ZOOGEOGRAPHICAL CONCLUSIONS

The Polynesian thomisid fauna has apparently arrived from two opposite directions, South America and Melanesia. These two elements are not known to be mixed in any part of Polynesia (map in Fig. 1).

New World element (*Mecaphesa*) probably first arrived in Hawaii, where an explosive speciation has taken place, resulting in 17 known species (Suman, 1970: in three genera), most having a small range up in the mountains. Galapagos Islands (1 or several spp.) and Juan Fernandez Islands constitute another possible source of immigration for the East Polynesian *Mecaphesa* spp. They have further evolved to at least six, but probably more local endemics. There are also sympatric montane species, at least in the Marquesas Islands, but most probably also in Tahiti. The majority of East Polynesian species live on mountain tops, but a few species have occassionally been recorded also in lowland.

The Oriental-New Guinean genus of the *Misumena*-group, here tentatively called *Massuria* has not been found in the intervening Melanesian archipelagoes and must be excluded from possible sources of origin of the east Polynesian *Mecaphesa*, although both groups belong to Misumenini, a group probably older than any mid-Pacific archipelagoes.

There are no known thomisids in the Central Polynesian islands (Cook Islands, Tokelau Islands, Niue, etc.) (Marples, 1955b, 1957, 1960, 1964) or in the low coral islands north of Samoa (Rainbow, 1897; Roewer, 1944). In spite of additional collecting both in the lowland as well as in the mountains of Rarotonga by myself, no *Mecaphesa* spp. have been observed. The absence of *Diaea praetexta* in disturbed lowland habitats of Rarotonga seems to show that anthropochorous dispersal of this species is not very effective, although its frequency in the more western archipelagoes can be partly explained by this type of short distance dispersal.

The Australian Thomisidae appear to have arrived through Melanesia, where Fiji and Vanuatu share the same common lowland species, '*Diaea*' *praetexta* and several closely related species are present in New Guinea and Eastern Australia. The other west Polynesian thomisid species, '*Tharrhalea*' *subtilis* belongs to a group that has a wider range including southeast Asia. In spite of intensive field work in Samoa and Tonga during 1991-92, there are still no montane thomisids known in the western archipelagoes of Polynesia.

There are some other Polynesian spiders of Neotropical origin (Anyphaenidae, some Theridiidae, etc.), but most spider families represented in Polynesia are of Melanesian, southeast Asian or New Zealand origin.

ACKNOWLEDGEMENTS

This study is part of a long range programme on Indo-Pacific spiders, including field and museum work during the last 20 years. This work has only been possible through the generous cooperation of numerous persons, who could not be listed separately here. Useful comments were also presented by two referees and an editor. The map was kindly drawn by Ms. Maija Mustonen, and the original English text was checked by Mrs Alice Moore.

LITERATURE CITED

BEATTY, J.A. & BERRY, J.W. 1988. Four new species of *Paratheuma* (Araneae, Desidae) from the Pacific. Journal of Arachnology 16: 339-347.

BEATTY, J.A., BERRY, J.W., & MILLIDGE, A.F. 1991. The Linyphiid spiders of Micronesia and Polynesia with notes on distribution and habitats. Bulletin of the British Arachnological Society 8: 265-274.

BERLAND, L. 1924. Araignées de l'ile de Pâques et des îles Juan Fernandez. The Natural History of Juan Fernandez and Easter Island 3: 419-437.

1927. Note sur les Araignées recueillies aux îles Marquises par le R.P. Siméon Delmas. Bulletin du Muséum National d'Histoire Naturelle, Paris 38: 366-368.

1928. Remarques sur la répartition et les affinités des Araignées du Pacifique. Proceedings of the Pan-Pacific Science Congress, 3, Tokyo (1): 1044-1054.

1929. Araignées (Aranеida). Insects of Samoa and other Samoan terrestrial Arthropoda, vol. 8: 35-78.

1930. Les Araignées des îles avoisinant la Nouvelle Zélande et les relations entre l'Australie et l'Amerique du Sud. Compte Rendu de Séances, Société de Biogeographie, Paris 1930(60): 90-94.

1933. Araignées des îles Marquises. Bulletin of the Bernice P. Bishop Museum 114 (Pacific Entomological Survey Publication 7): 39-70.

1934a. Les Araignées du Pacifique. Contribution à l'étude du peuplement zoologique et botanique des îles du Pacifique. Publ. Soc. Biogéographie 4: 155-180.

1934b. Les Araignées de Tahiti. Bulletin of the Bernice P. Bishop Museum 113 (Pacific Entomological Survey Publication 6(21)): 97-107.

1934c. Araignées de Polynésie. Annales de la Société Entomologique de France 103: 321-336.

1935a. Nouvelles Araignées marquisiennes. Bulletin of the Bernice P. Bishop Museum 142 (Pacific Entomological Survey Publication 8(4)): 31-63.

1935b. Les Araignées des îles Marquises et la Biogéographie. Compte Rendu de Séances, Société de Biogeographie, Paris 100: 27-28.

1937. Comment les Araignées ont peuplé le Pacifique. Bulletin de la Société Océanographique 1: 77-80.

1938a. Araignées des Nouvelles Hébrides. Annales de la Société Entomologique de France 107: 121-190.

1938b. Liste des Araignées recueillis à Maupiti (îles de la Societe) par M. Ropiteau. Bulletin de la Société étude Océanographique 6: 47-48.

1942. Polynesian spiders. Occasional Papers of the Bernice P. Bishop Museum 17: 1-24.

1947. Araignées. XVI. in Croisière du Bougainville aux îles australes françaises. Mémoires du Muséum National d'Histoire Naturelle, Paris 20: 53-54.

BERRY, J. & BEATTY, J. 1987. Biogeography of Pacific Island spiders: a progress report. American Arachnology 36: 3.

BONNET, P. 1957. Bibliographia Araneorum 2(3): 1927-3026. (Les Artisans de L'Imprimerie Douladoure: Toulouse).

BÖSENBERG, H. & STRAND, E. 1906. Japanische Spinnen. Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft in Frankfurt a. Main 30: 93-422.

CAPORIACCO, L. Di, 1954. Araignées de la Guyane Française du Museum d'Histoire Naturelle de Paris. Commentationes Pontificiae Academia Scientiarum 16: 45-193.

CARSON, H.L. 1984. Speciation and the Founder Effect on a New Oceanic Island. PP. 45-54. In, Radovsky, F.J., Raven, P.H. and Sohmer, S.H. (eds), Biogeography of the Tropical Pacific.

CHRYSANTHUS, FR. 1964. Spiders from South New Guinea VI. Nova Guinea, Zoology 28: 87-104.

CRAW, R. 1978. Two biogeographical frameworks: Implications for the biogeography of New Zealand. A review. Tuatara 23: 81-114.

1983. Panbiogeography and vicariance cladistics: Are they truly different? Syst. Zool. 32: 431-437.

DALRYMPLE, G.P., SILVER, E.A. & JACKSON, E.D. 1975. Origin of the Hawaiian Islands. In: Skinner, B.J. (ed.), Earth's history, structure, and materials. Readings from American Scientist: 112-126.

DIPPENAAR-SCHOEMAN, A.S. 1983. The spider genera *Misumena*, *Misumenops*, *Runcinia* and *Thomisus* (Araneae, Thomisidae) of southern Africa. Entomology Memoirs of the Department of Agriculture, Republic of South Africa 55: 1-66.

DONDALE, C.D. & REDNER, J.H. 1978. The crab spiders of Canada and Alaska. Araneae: Philodromidae and Thomisidae. The Insects and Arachnids of Canada 5: 255 pp. (Supply and Services Canada: Hull).

DUNCAN, R.A. & MCDOUGALL, I. 1974. Migration of volcanism with time in the Marquesas Islands, French Polynesia. Earth and Planetary Science Letters 21: 414-420.

FOSBERG, F.R. 1991. Pacific Oceanic Island Biodiversity in a geohistoric perspective. Proceedings of the XVII Pacific Science Congress, Honolulu: 71-73.

GRESSITT, J.L. 1961. Problems in the zoogeography of Pacific and Antarctic Insects. Pacific Insects Monograph 2: 1-94.

GRESSITT, J.L. & YOSHIMOTO, C.M. 1963. Dispersal of animals in the Pacific. Pp. 283-293. In, Gressitt, J.L. (ed.), Pacific Basin Biogeography.

KOCH, L. & KEYSERLING, E. 1871-1886. Die Arachniden Australiens, nach der Natur beschrieben und abgebildet. 1489 pp. (Bauer and Raspe: Nürnberg). (Thomisidae 1874: 492-610 and 1876: 742-824).

KULCZYNSKI, W. 1911. Spinnen aus Süd-Neu-Guinea. Nova Guinea 9 (Zoology 2): 109-148.

LEHTINEN, P.T. 1980. Arachnological zoogeography of the Indo-Pacific Region. Verhandlungen des 8. Internationalen Arachnologen-Kongreß, Wien, 1980: 499-504.

LEVY, G. 1985. Araneae: Thomisidae. Fauna Palaestina, Arachnida, vol. II: 1-115. (Israel Academy of Sciences and Humanities: Jerusalem).

LOERBROKS, A. 1983. Revision der Krabbenspinnengattung *Heriaeus* Simon (Arachnida: Araneae: Thomisidae). Verhandlungen des Naturhistorischen Museum in Hamburg (N.F.) 26: 85-139.

MARPLES, B.J. 1955a. Spiders from Western Samoa. Journal of the Linnean Society of London, Zoology 42: 453-504

1955b. Spiders from some Pacific Islands. Pacific Science 9: 69-76.
1957. Spiders from some Pacific Islands II. Pacific Science 11: 386-395.
1959. Spiders from South Pacific Islands III. The Kingdom of Tonga. Pacific Science 13: 362-367.
1960. Spiders from some Pacific islands, part IV. The Cook Islands and Niue. Pacific Science 14: 382-388.
1964. Spiders from some Pacific Islands V. Pacific Science 18: 399-410.

MELLO-LEITÃO, C.F. DE 1929. Aphantochilidas e Thomisidas do Brasil. Archivos do Museu Nacional, Rio de Janciro 31: 9-358.

NELSON, G. & PLATNICK, N.I. 1981. Systematics and biogeography: cladistics and vicariance. (Columbia University Press: New York).

NUR, A. & BEN-AVRAHAM, Z. 1977. Lost Pacifica Continent. Nature 270: 41-43.

ONO, H. 1988. A revisional study of the spider family Thomisidae (Arachnida, Araneae) of Japan. (National Science Museum: Tokyo).

PLATNICK, N.I. & NELSON, G. 1988. Spanning-tree biogeography: shortcut, detour, or dead-end? Systematic Zoology 37: 410-419.

RAINBOW, W.J. 1897. The Arachnidan fauna of Funafuti. Memoirs of the Australian Museum 3: 105-125.
1902. Arachnida from the South Seas. Proceedings of the Linnean Society of New South Wales 26: 521-532.

RINALDI, I.M.P. 1983. Contribuiçao ao estudo das Misumeninae do Brasil (Araneae, Thomisidae). Revista Brasileira de Entomologia 27: 147-153.

ROEWER, C.F. 1944. Einige Araneen von Prof. Dr. Sixten Bocks Pazifik-Expedition 1917-1918. Meddelanden från Göteborgs Museum Zoologiska Avdelning 104: 1-10.

ROEWER, C.F. 1954. Katalog der Araneae von 1758 bis 1954, vol. IIA. (Institut Royal des Sciences Naturelles de Belgique: Bruxelles).

SCHICK, R.X. 1965. The crab spiders of California (Araneae, Thomisidae). Bulletin of the American Museum of Natural History 129: 1-180.

SIMON, E. 1895. Histoire Naturelle des Araignées, vol. 1(4): 761-1084. (Librairie Encyclopédique de Roret: Paris).
1900. Arachnida. Pp. 443-519. In, Sharp, D. (ed.), Fauna Hawaiiensis, or the Zoology of the Sandwich Isles, vol. 2. (Cambridge University Press: Cambridge).

STODDART, D.R. 1968. Isolated island communities. Science Journal 4: 32-38.

STRAND, E. 1913. Neue indoaustralische und polynesische Spinnen des Senckenbergischen Museums. Archiv für Naturgeschichte 1913 A 6: 113-123.

SUMAN, T.W. 1970. Spiders of the family Thomisidae in Hawaii. Pacific Insects 12: 773- 864.

TIKADER, B.K. 1980. Thomisidae (crab-spiders). The Fauna of India, Araneae, vol. 1, part 1: 1-247.

TOLEDO PIZA, S. 1937. Novos Thomisidos do Brazil. Folia de Clinic. Biologia, São Paulo 9: 179-183.

WILSON, J. TUZO. 1963. Continental drift. Scientific American 208: 86-100.